third day following the halos. In the Rocky Mountain and plateau regions halos were reported, mostly in the upper Missouri valley, on thirteen dates. On nine dates rain or snow fell on the same day; on six dates on the second day; and on one date on the third day following the halos. On the Pacific coast halos were reported, mostly on the north Pacific coast, on thirteen dates. On ten dates rain fell on the same day; on seven dates on the second day; and on five dates on the third day following the halos. The above statement shows that in the Atlantic coast states 96 per cent. of the halos were attended by rain or snow on the same date; that 90 per cent. were followed on the second date, and 82 per cent. on the third date by rain or snow. In the central valleys 90 per cent. of the halos were attended by rain or snow on the same date; 90 per cent. were followed on the second date; and 79 per cent. on the third date by rain or snow. In the Rocky Mountain and plateau regions 69 per cent. of the halos were attended by rain or snow on the same date; 46 per cent. were followed on the second date, and 8 per cent. on the third date by rain or snow. On the Pacific coast 77 per cent. of the halos were attended by rain or snow on the same date; 54 per cent. were followed on the second date, and 38 per cent. on the third date by rain or snow. It is also shown that in the Atlantic coast states 50 per cent. of the halos appeared in advance of low pressure storms, and 50 per cent. were reported following the passage of storm areas or within areas of high pressure. In the central valleys 38 per cent. of the halos appeared to the eastward of low pressure storms, and 62 per cent. were observed in the west quadrants of low pressure storms or within areas of high pressure. In the Rocky Mountain and plateau regions 46 per cent. of the halos appeared in the eastern quadrants, and 54 per cent. to the westward of low pressure storms. On the Pacific coast but 8 per cent. of the halos attended or preceded the approach of low pressure storms, while 92 per cent. were noted to the west or northwest of areas of low pressure.

It therefore appears that the halos of the current month generally occurred within the influence of low pressure storms; that in practically every instance rain or snow fell at or near the stations reporting halos on the date of their occurrence; that the rain or snow of the second and third dates following the halos attended the disturbed and humid condition of the atmosphere following general disturbances; and that the halos occurred most frequently in the west quadrants of areas of low pressure.

METEORS.

Brilliant meteors were reported as follows: 8th, New London, Conn. 13th, Spearfish, S. Dak. 14th, Buffalo and Rochester, N. Y. 24th, Cumberland and Woodstock, Md. 25th, Galena, Md. Meteors were also reported on the 2d, at Clinton and Fayette, Iowa. 3d, Peoria, Ill. 8th, New London, Conn., and Sioux City, Iowa. 13th, Woodbury, N. J. 14th, Ithaca, N. Y., and Catawissa, Pa. 15th, Beverly, N. J. 18th, McCausland, Iowa, and Yellow Springs, Ohio. 20th, Dubuque, Iowa. 29th and 30th, Dale Enterprise, Va.

MIRAGE.

Mirage were observed during the month as follows: 3d, Wahpeton, N. Dak. 7th, Tribune, Kans.; Wolsey, S. Dak. 9th, Woonsocket, S. Dak. 12th, Napoleon, N. Dak. 13th, Woonsocket, S. Dak. 17th, Sundance, Wyo. 18th, Hay Springs, Nebr. 23d, Tribune, Kans. 25th and 26th, Woonsocket, S. Dak. 27th, Napoleon, N. Dak.; Webster and Woonsocket, S. Dak. 28th and 29th, Tribune, Kans.; Woonsocket, S. Dak. 30th and 31st, Woonsocket, S. Dak.

Spearfish, S. Dak.: a very fine mirage occurred on the 5th, beginning about 8 a. m. and lasting nearly an hour. The ground west and northwest of Crow Peak, and between this place and Beulah, seemed to be lifted hundreds of feet above all the intervening high land which ordinarily shuts them off from view, and every belt of timber, ravine, or gulch, the course of the Redwater for miles, and even the ranches with smoke ascending from dwellings, were plainly seen.

Wolsey, S. Dak.: on the 25th, at 3 p. m., and on the 28th, from 8 a. m. to 10 a. m., unusually bright and distinct mirage were seen. The country for fifteen to twenty miles in every direction was plainly presented to view, and a freight train of ten cars, twelve miles distant could be seen.

SUN SPOTS.

Haverford College Observatory, Pa. (observed by Prof. F. P. Leavenworth):

Date.	Number of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculæ.	Remarks.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	
Jan., 1890.										
3, 11 a. m ...	0	0	0	0	0	0	1	1	0	Definition poor.
4, 11 a. m ...	0	0	0	0	0	0	1	1	0	Definition poor.
6, 11 a. m ...	0	0	0	0	0	0	1	1	0	Definition very poor.
8, 11 a. m ...	0	2	0	0	0	0	1	3	1	Definition poor.
9, 10 a. m ...	1	2	7	3	0	0	1	2	0	Definition very poor.
11, 3 p. m ...	0	0	0	0	0	0	0	0	2	Definition good.
12, 3 p. m ...	2	3	0	0	0	0	2	3	4	Definition fine, spots small.
13, 3 p. m ...	0	0	0	0	0	0	0	0	2	Definition fair.
14, 11 a. m ...	0	0	0	0	0	0	0	0	0	Definition poor.
16, 2 p. m ...	1	6	0	0	0	0	1	6	2	Definition fair, spots small.
17, 10 a. m ...	0	2	0	0	0	0	1	8	3	Definition good.
18, 12 m.....	0	6	0	0	0	0	1	14	1	Definition fine.
19, 11 a. m ...	0	10	0	0	0	0	1	24	0	Definition fine, 2 large spots.
21, 1 p. m ...	0	0	0	0	0	0	1	6	1	Definition good, 1 large spot.
22, 11 a. m ...	0	0	0	0	0	0	1	2	1	Definition poor.
24, 9 a. m ...	0	0	1	2	0	0	0	0	4	Definition poor.
25, 2 p. m ...	0	0	0	0	0	0	0	0	0	Definition very poor.
27, 9 a. m ...	0	0	0	0	0	0	0	0	3	Definition poor.
28, 10 a. m ...	0	0	0	0	0	0	0	0	3	Definition poor.
29, 10 a. m ...	0	0	0	0	0	0	0	0	0	Definition poor.
30, 11 a. m ...	1	4	0	0	0	0	1	4	1	Definition good.

Mr. C. E. Buzzell, Leaf River, Ill.: the group of December 27th was observed January 2d and 3d. Clouds, 4th to 7th. 9th, two small spots observed in high latitude one day past meridian. Clouds, 10th, 11th, 12th. 16th, one small spot in low latitude one day west of meridian, increasing on 18th and forming three groups on 20th; passed west limb 21st. Clouds, 22d to 26th. 30th, small group one day in on east limb, increasing to two groups on 31st, and subsiding to one small group on February 1st.

Mr. John W. James, Riley, Ill.: a large single spot on the sun's meridian 1st to 2d; disappeared by solar rotation, 7th or 8th. None seen the rest of the month.

Mr. M. A. Vedder, Lyons, N. Y.: the large spot that appeared by rotation on December, 26th was seen nearing the western limb on January 4th. On January 20th and 21st two large spots were seen close to the western limb; this disturbance probably appeared by rotation on January 9th, spots forming during the transit. Faint groups of faculæ were seen near the eastern limb on January 14th and 28th. Observations were poor or lacking on nearly all other days.

Mr. H. D. Gowey, North Lewisburgh, Ohio: sun spots 3d, 21st.

VERIFICATIONS.

FORECASTS FOR 24 HOURS IN ADVANCE.

[Verifications made by Assistant Professor C. F. Marvin, assisted by Mr. H. E. Williams, chief clerk of the Forecast Division.]

The forecasts for districts east of the Rocky Mountains for January, 1890, were made by Captain H. H. C. Dunwoody, 4th Artillery, Signal Officer, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps.

Percentages of forecasts verified, January, 1890.

States.		States.	
Maine	84.0	Kentucky	84.1
New Hampshire	84.1	Ohio	84.5
Vermont	84.2	West Virginia	84.9
Massachusetts	86.1	Indiana	87.7
Rhode Island	83.7	Illinois	85.3
Connecticut	80.4	Lower Michigan	85.3
Eastern New York	83.0	Upper Michigan	82.1
Western New York	82.4	Wisconsin	84.7
Eastern Pennsylvania	86.3	Minnesota	82.9
Western Pennsylvania	83.7	Iowa	84.1
New Jersey	81.9	Kansas	87.4
Delaware	82.5	Nebraska	83.4
Maryland	84.4	Missouri	85.0
District of Columbia	85.7	Colorado	82.8
Virginia	87.4	North Dakota	78.7
North Carolina	88.5	South Dakota	81.7
South Carolina	87.2	Southern California*	88.3
Georgia	89.1	Northern California*	86.9
Eastern Florida	95.2	Oregon*	90.8
Western Florida	94.3	Washington*	87.8
Alabama	89.5	*By elements:* Weather	85.8
Mississippi	86.8	Temperature†	84.5
Louisiana	87.0		
Texas	90.2	Monthly percentage of weather and temperature combined‡	85.3
Arkansas	87.5		
Tennessee	84.1		

* In determining the monthly percentage of weather and temperature combined, the Pacific coast states are not included. † The forecasts of temperature in districts east of the Rocky Mountains for January, 1890, were made with reference to the maximum temperature alone; that is, a prediction of warmer or cooler indicated that the maximum temperature of the day designated would be higher or lower than the maximum of the previous day. ‡ The monthly percentage of weather and temperature combined is determined by multiplying the percentage of weather by 6, and the percentage of temperature by 4, and dividing their sum by 10.

FORECASTS FOR 48 HOURS IN ADVANCE.

Appreciating the great importance that long time predictions possess for the general public the Chief Signal Officer has authorized forecasts for forty-eight and seventy-two hours, covering the second and third days in advance. Such forecasts are optional with the predicting officer, and are only made when clearly in the public interest, and cover, in all cases, considerable areas of country, and are not confined to localities.

Percentages of verifications of forecasts made for second day in advance. Number of predictions made: weather, 2; temperature, 51. Percentages of verifications: weather, 100; temperature, 85.7. Weather and temperature combined, 86.5.

No forecasts for seventy-two hours were made during the month.

CAUTIONARY SIGNALS FOR JANUARY, 1890.

Statement showing percentages of justifications of wind signals for the month of January, 1890:

Wind signals.—(Ordered by Captain H. H. C. Dunwoody.) Total number of signals ordered, ninety; justified as to velocity, wholly, seventy-six, partly, four; justified as to direction, eighty-three. Of the signals ordered, sixty-two were cautionary, of which fifty-two were wholly, and two partly, justified; and twenty-eight were storm signals, of which twenty-four were wholly, and two partly, justified. Sixteen signals were ordered for easterly winds, of which twelve were justified, and seventy-four were ordered for westerly winds, of which seventy-one were justified. Percentage of justifications, 74.7.

Cold-wave signals.—(Ordered by Assistant Professor T. Russell.) Total number of signals ordered, three hundred and ninety-five; justified, two hundred and sixty-three. Percentages of justifications, 66.6.

Percentages of local verifications of weather and temperature signals reported by directors of the various State Weather Services for January, 1890.

States.	Weather.	Temperature.	States.	Weather.	Temperature.
Indiana	83.0	85.0	New Jersey	86.9	88.2
Kansas	88.9	91.0	New York	88.5	84.0
Michigan	82.4	75.5	Ohio	88.0	86.0
Minnesota	81.0	82.0	Pennsylvania	85.0	83.0
Missouri	86.0	85.0	South Carolina	80.0	87.8
Nebraska	89.8	91.8			

STATE WEATHER SERVICES.

[*Temperature in degrees Fahrenheit; precipitation, including melted snow, in inches and hundredths.*]

The following extracts and summaries are republished from reports for January, 1890, of the directors of the various state weather services:

ALABAMA.

The weather was spring-like throughout the month, and the rainfall was small for a winter month.

Temperature.—Highest monthly mean, 63, at Citronelle; lowest monthly mean, 49, at Valley Head; maximum, 84, at Citronelle, 7th; minimum, 17, at Elkmont, 22d; greatest local monthly range, 58, at Citronelle and Elkmont; least local monthly range, 44, at Mobile.

Precipitation.—Greatest monthly, 6.33, at Tuscumbia; least, 0.60, at Mobile.

Wind.—Prevailing directions, south and southwest.—*P. H. Mell, Signal Corps, Auburn, director.*

ARKANSAS.

Temperature.—The average was 8.1 higher than for January, 1889. Highest monthly mean, 56.2, at Washington; lowest monthly mean, 40.2, at Winslow; maximum, 81, at Lead Hill, 26th; minimum, 10, at Winslow, 16th.

Precipitation.—The average precipitation was one inch greater than that of last year. Greatest monthly, 9.46, at Ozone; least monthly, 3.97, at Fort Smith.—*M. F. Locke, Commissioner of Agriculture, Little Rock, director; W. U. Simons, Sergeant, Signal Corps, assistant.*

COLORADO.

Temperature.—The monthly mean for the state was 4 above the average of the last three years. Highest monthly mean, 33.4, at Cañon City; lowest monthly mean, 4.5, at Gunnison; maximum, 84, at Breckenridge; minimum, —39, at Gunnison; greatest local monthly range, 110, at Breckenridge; least local monthly range, 45, at Moraine.

Precipitation.—The monthly precipitation was about the average; greatest monthly, 2.08, at Durango; least monthly, 0.00, at Monte Vista.

Wind.—Prevailing direction, west.—*Prof. F. H. Loud, Colorado Springs, director; W. S. Miller, Corporal, Signal Corps, assistant.*

ILLINOIS.

Temperature.—The mean temperature for the month was 10 above the normal of the past fifteen years; maximum, 74, at Jordan's Grove, Mascoutah, and McLeansborough, 12th; minimum, —13, at Woodstock, 22d.

Precipitation.—The average for the month was about 3.37 above the normal of the past twelve years; greatest monthly, 14.62, at Atwood; least monthly, 1.64, at Sycamore.

Wind.—Prevailing direction, northwest.—*John Craig, Sergeant, Signal Corps, Springfield, in charge.*

INDIANA.

Temperature.—The month was warm throughout; the mean temperature is the highest on record for any month of January for the last nine years, except January, 1880, which was warmer; highest monthly mean, 45.7, at Marengo; lowest monthly mean, 33.5, at Logansport; maximum, 72, at Scalesville, 11th; minimum, —3, at La Fayette, 24th; greatest local monthly range, 73, at LaFayette; least local monthly range, 51, at Marengo.

Precipitation.—The precipitation, mainly in the form of rain, was greatly in excess, in fact the amounts are the greatest ever measured in Indiana in any January on record; the average excess above the normal is 3.76; greatest monthly, 11.90, at Huntingburgh; least monthly, 2.48, at Logansport.

Wind.—Prevailing direction, southwest.—*Prof. H. A. Huston, La Fayette, director; C. F. R. Wappenhans, Sergeant, Signal Corps, assistant.*

IOWA WEATHER CROP BULLETIN SERVICE.

Temperature.—Highest monthly mean, 28.9, at Keokuk; lowest monthly mean, 11.2, at Larrabee; maximum, 64, at Keokuk, 11th; minimum, —27, at Fayette, 22d; greatest local monthly range, 81, at Glenwood; least local monthly range, 56, at Maquoketa.

Precipitation.—Greatest, 3.80, at Grinnell; least, 0.99, at Larrabee.

Wind.—Prevailing direction, northwest.—*G. M. Chappel, Sergeant, Signal Corps, Des Moines, in charge, Iowa Weather Crop Bulletin Service.*

KANSAS.

Temperature.—The mean temperature for the month was 2 above the normal; highest monthly mean, 37.8, at Oswego; lowest monthly mean, 19.4, near Concordia; maximum, 79, at Englewood, 9th and 30th; minimum, —22,